WHAT IS CLAIMED IS:

1. A channel noise estimating method applied to a multi-carrier system consisting of K subchannels over which original data symbols ($X_k[n]$) (where n is the discrete time index, $k \in \{1,2,\ldots,K\}$ is the subchannel index) are transmitted in a frequency-domain from a transmitting unit to a receiving unit, the noise estimating method comprising the acts of:

reconstructing simulated input data symbols ($X'_k[n]$) that simulate the original data symbols ($X_k[n]$);

delaying the actual received data symbols ($R_k[n]$) such that the delayed actual received data symbols ($Q_k[n]$) are synchronous to the simulated input data symbols ($X'_k[n]$);

calculating a channel response estimate ($W_k[n]$) of one subchannel k based on said delayed actual received data symbols ($Q_k[n]$) and said simulated input data symbols ($X'_k[n]$) according to the Least Mean Square algorithm;

estimating virtual received data symbols ($Y_k[n]$) based on said channel response estimate ($W_k[n]$) and the simulated input data symbol ($X'_k[n]$); and

calculating a different quantity ($e_k[n]$) between the delayed actual received data symbol ($Q_k[n]$) and the estimated virtual received data symbols ($Y_k[n]$) to represent the channel noise of said subchannel k.

2. The method as claimed in claim 1, in the simulated input data symbols ($X'_k[n]$) reconstructing act, the original data symbols ($X_k[n]$) being taken as the simulated input data symbols ($X'_k[n]$) while the original data symbols ($X_k[n]$) are exactly known to the receiving unit.

3. The method as claimed in claim 1, the simulated input data symbols

($X'_k[n]$) reconstructing act further having:

de-mapping and decoding the actual received data symbols ($R_k[n]$) on each subchannel k to extract bit-stream data; and

encoding and mapping said bit-stream data to reconstruct said simulated input data symbols ($X'_k[n]$).

4. The method as claimed in claim 3, wherein the simulated input data symbols ($X'_k[n]$) reconstructing act further has a de-interleaving act after the actual received data symbols ($R_k[n]$) de-mapping act, and an interleaving act after the bit-stream data encoding act.

5. The method as claimed in claim 1, in the simulated input data symbols ($X'_k[n]$) reconstructing act, said actual received data symbols ($R[n]$) on the subchannel k being directly mapped to form the simulated input data symbol ($X'_k[n]$) for said subchannel k.

6. A channel noise estimating apparatus applied to a multi-carrier system consisting of K subchannels over which original data symbols ($X_k[n]$) (where n is the discrete time index, $k \in \{1,2,\ldots,K\}$ is the subchannel index) are transmitted in a frequency-domain from a transmitting unit to a receiving unit, the noise estimating apparatus comprising:

a reconstructing unit for generating simulated input data symbols ($X'_k[n]$) that simulate the original data symbols ($X_k[n]$);

a D-tap delay line provided to delay actual received data symbols ($R_k[n]$) that are received by the receiving unit such that the delayed actual received data symbols ($Q_k[n]$) are synchronous to the simulated input data symbols ($X'_k[n]$), wherein D is an integer greater than or equal to zero;

a channel response estimating unit, which estimates a channel response estimate ($W_k[n]$) of one subchannel k based on said delayed actual received data symbols ($Q_k[n]$) and said simulated input data symbols ($X'_k[n]$) according to the Least Mean Square algorithm;

a channel noise calculating unit corresponding to said channel response estimating unit, where the channel noise calculating unit estimates virtual received data symbols ($Y_k[n]$) based on said channel response estimate ($W_k[n]$) and the simulated input data symbol ($X'_k[n]$);

wherein the channel noise calculating unit further calculates a different quantity ($e_k[n]$) between the delayed actual received data symbol ($Q_k[n]$) and the estimated virtual received data symbols ($Y_k[n]$) to represent the channel noise of said subchannel k.

7. The apparatus as claimed in claim 6, wherein while the original data symbols ($X_k[n]$) are exactly known to the receiving unit, the reconstructing unit takes the original data symbols ($X_k[n]$) as the simulated input data symbols ($X'_k[n]$), and the actual received data symbols are directly passed through the delay line without a delaying process.

8. The apparatus as claimed in claim 6, wherein the reconstructing unit based on the actual received data symbols $R_k[n]$ on each subchannel k generates simulated input data symbols ($X'_k[n]$).

9. The apparatus as claimed in claim 8, the reconstructing unit having:

a bit-stream data extractor, which de-maps and decodes the actual received data symbols $R_k[n]$ on each subchannel k to construct the bit-stream data of the actual received data symbol; and

a constructor, which encodes, and maps said bit stream data to reconstruct said simulated input data symbols ($X'_k[n]$) for each subchannel k.

10. The apparatus as claimed in claim 9, said bit-stream data extractor further including a de-interleaver, and said constructor further including an interleaver.

11. The apparatus as claimed in claim 8, wherein the reconstructing unit directly maps said actual received data symbols ($R_k[n]$) on the subchannel k to form the simulated input data symbol ($X'_k[n]$) for said subchannel k.